

What is claimed is:

1 1. A system for evaluating cardiac performance relative to
2 performance of an intrathoracic pressure maneuver, comprising:
3 an implantable medical device to indirectly sense blood pressure by
4 directly collecting intracardiac impedance measures; and
5 an analysis component to evaluate cardiac functional changes to the blood
6 pressure in response to performance of an intrathoracic pressure maneuver.

1 2. A system according to Claim 1, wherein the blood pressure
2 comprises at least one of arterial pressure, cardiac chamber pressure, systolic
3 pressure, and diastolic pressure.

1 3. A system according to Claim 2, wherein the cardiac chamber
2 pressure comprises left ventricular end diastolic pressure.

1 4. A system according to Claim 1, wherein the implantable medical
2 device comprises at least one of a bradycardia, tachycardia, heart failure, therapy
3 delivery, and monitoring device.

1 5. A system according to Claim 1, further comprising:
2 at least one lead to couple to the implantable medical device and to sense
3 at least one of the intracardiac impedance measures across the thoracic cavity and
4 the intracardiac impedance measures across the heart.

1 6. A system according to Claim 1, wherein the intrathoracic pressure
2 maneuver comprises at least one of a Valsalva and Müller maneuver.

1 7. A system according to Claim 1, further comprising:
2 an evaluation subcomponent to evaluate at least one of overdamping and
3 underdamping cardiac impedance response relative to normative levels.

1 8. A system according to Claim 7, further comprising:
2 a notification subcomponent to generate a notification responsive to the at
3 least one of overdamping and underdamping cardiac impedance response.

1 9. A system according to Claim 1, wherein thoracic pressure is
2 monitored during the intrathoracic pressure maneuver.

1 10. A system according to Claim 9, further comprising:
2 an external pressure monitor to define a confined volume configured to
3 receive a forced exhalation and to measure the thoracic pressure relative to the
4 confined volume.

1 11. A system according to Claim 9, further comprising:
2 a thoracic pressure sensor to internally measure thoracic pressure.

1 12. A method for evaluating cardiac performance relative to
2 performance of an intrathoracic pressure maneuver, comprising:
3 indirectly sensing blood pressure by directly collecting intracardiac
4 impedance measures through an implantable medical device; and
5 evaluating cardiac functional changes to the blood pressure in response to
6 performance of an intrathoracic pressure maneuver.

1 13. A method according to Claim 12, wherein the blood pressure
2 comprises at least one of arterial pressure, cardiac chamber pressure, systolic
3 pressure, and diastolic pressure.

1 14. A method according to Claim 13, wherein the cardiac chamber
2 pressure comprises left ventricular end diastolic pressure.

1 15. A method according to Claim 12, wherein the implantable medical
2 device comprises at least one of a bradycardia, tachycardia, heart failure, therapy
3 delivery, and monitoring device.

1 16. A method according to Claim 12, further comprising:
2 sensing at least one of the intracardiac impedance measures across the
3 thoracic cavity and the intracardiac impedance measures across the heart.

- 1 17. A method according to Claim 12, wherein the intrathoracic
2 pressure maneuver comprises at least one of a Valsalva and Müller maneuver.
- 1 18. A method according to Claim 12, further comprising:
2 evaluating at least one of overdamping and underdamping cardiac
3 impedance response relative to normative levels.
- 1 19. A method according to Claim 18, further comprising:
2 generating a notification responsive to the at least one of overdamping and
3 underdamping cardiac impedance response.
- 1 20. A method according to Claim 12, further comprising:
2 monitoring thoracic pressure during the intrathoracic pressure maneuver.
- 1 21. A method according to Claim 20, further comprising:
2 defining a confined volume configured to receive a forced exhalation; and
3 measuring the thoracic pressure relative to the confined volume.
- 1 22. A method according to Claim 20, further comprising:
2 internally measuring thoracic pressure.
- 1 23. An apparatus for evaluating cardiac performance relative to
2 performance of an intrathoracic pressure maneuver, comprising:
3 means for indirectly sensing blood pressure by directly collecting
4 intracardiac impedance measures through an implantable medical device; and
5 means for evaluating cardiac functional changes to the blood pressure in
6 response to performance of an intrathoracic pressure maneuver.
- 1 24. A system for assessing cardiac performance through transcardiac
2 impedance monitoring, comprising:
3 an implantable medical device to directly collect intracardiac impedance
4 measures;
5 a correlation component to correlate the intracardiac impedance measures
6 to cardiac dimensional measures relative to performance of an intrathoracic

7 pressure maneuver and to group the cardiac dimensional measures into at least
8 one measures set corresponding to a temporal phase of the intrathoracic pressure
9 maneuver; and
10 an analysis component to evaluate the at least one cardiac dimensional
11 measures set against a cardiac dimensional trend for the corresponding
12 intrathoracic pressure maneuver temporal phase to represent cardiac performance.

1 25. A system according to Claim 24, wherein the cardiac dimensional
2 measures comprise at least one of cardiac stroke volume, left ventricular ejection
3 fraction, left ventricular end diastolic dimension, and left ventricular end systolic
4 dimension.

1 26. A system according to Claim 24, further comprising:
2 a history subcomponent to evaluate a history of cardiac performance
3 representations; and
4 a trending subcomponent to recognize a trend within the history indicating
5 at least one of cardiovascular disease absence, onset, progression, regression, and
6 status quo.

1 27. A system according to Claim 24, further comprising:
2 a characteristic signature formed with the cardiac dimensional trends over
3 the performance of the intrathoracic pressure maneuver; and
4 a comparison subcomponent to compare an overall cardiac dimensional
5 profile comprising the at least one cardiac dimensional measures set to the
6 characteristic signature to form a cardiac performance assessment.

1 28. A system according to Claim 27, further comprising:
2 a predefined threshold with the comparison module to analyze the cardiac
3 performance assessment relative to the predefined threshold.

1 29. A system according to Claim 28, further comprising:
2 a notification generated responsive to the cardiac performance assessment
3 substantially non-complying to the predefined threshold.

1 30. A system according to Claim 24, wherein the intrathoracic pressure
2 maneuver comprises the Valsalva maneuver, further comprising:
3 a collection subcomponent to collect the intracardiac impedance measures
4 relative to performance of the Valsalva maneuver.

1 31. A system according to Claim 30, further comprising:
2 a phase subcomponent to specify four phases physiologically
3 corresponding to the performance of the Valsalva maneuver, comprising defining
4 Phase I corresponding to initial strain, defining Phase II corresponding to strain
5 duration and cessation of breathing, defining Phase III corresponding to strain
6 discontinuation and resumption of normal breathing, and defining Phase IV
7 corresponding to recovery.

1 32. A system according to Claim 31, further comprising:
2 a trending subcomponent to identify an overshoot of the cardiac
3 dimensional during the Phase IV.

1 33. A system according to Claim 32, wherein the trending
2 subcomponent further comprises identifying an increase of the cardiac
3 dimensional during the Phase I, identifying a transient decrease of the cardiac
4 dimensional during the Phase II, identifying a sharp decrease of the cardiac
5 dimensional during the Phase III, and identifying an increase preceding the
6 overshoot and a decrease of the cardiac dimensional during the Phase IV.

1 34. A system according to Claim 24, further comprising:
2 a programming subcomponent to provide programming support to the
3 implantable medical device.

1 35. A system according to Claim 24, wherein the implantable medical
2 device comprises at least one of an implantable cardiac pacemaker, implantable
3 cardioverter defibrillator, implantable cardiac resynchronization device,
4 implantable cardiovascular monitor, and therapeutic device monitoring and
5 treating structural problems of the heart.

1 36. A system according to Claim 24, further comprising:
2 a database to maintain the intracardiac impedance measures.

1 37. A system according to Claim 24, wherein the intrathoracic pressure
2 maneuver comprises at least one of the Valsalva maneuver and Müller maneuver.

1 38. A method for assessing cardiac performance through transcardiac
2 impedance monitoring, comprising:
3 directly collecting intracardiac impedance measures through an
4 implantable medical device;
5 correlating the intracardiac impedance measures to cardiac dimensional
6 measures relative to performance of an intrathoracic pressure maneuver;
7 grouping the cardiac dimensional measures into at least one measures set
8 corresponding to a temporal phase of the intrathoracic pressure maneuver; and
9 evaluating the at least one cardiac dimensional measures set against a
10 cardiac dimensional trend for the corresponding intrathoracic pressure maneuver
11 temporal phase to represent cardiac performance.

1 39. A method according to Claim 38, wherein the cardiac dimensional
2 measures comprise at least one of cardiac stroke volume, left ventricular ejection
3 fraction, left ventricular end diastolic dimension, and left ventricular end systolic
4 dimension.

1 40. A method according to Claim 38, further comprising:
2 evaluating a history of cardiac performance representations; and
3 recognizing a trend within the history indicating at least one of
4 cardiovascular disease absence, onset, progression, regression, and status quo.

1 41. A method according to Claim 38, further comprising:
2 forming a characteristic signature with the cardiac dimensional trends over
3 the performance of the intrathoracic pressure maneuver; and

4 comparing an overall cardiac dimensional profile comprising the at least
5 one cardiac dimensional measures set to the characteristic signature to form a
6 cardiac performance assessment.

1 42. A method according to Claim 41, further comprising:
2 analyzing the cardiac performance assessment relative to a predefined
3 threshold.

1 43. A method according to Claim 42, further comprising:
2 generating a notification responsive to the cardiac performance assessment
3 substantially non-complying to the predefined threshold.

1 44. A method according to Claim 38, wherein the intrathoracic
2 pressure maneuver comprises the Valsalva maneuver, further comprising:
3 collecting the intracardiac impedance measures relative to performance of
4 the Valsalva maneuver.

1 45. A method according to Claim 44, further comprising:
2 specifying four phases physiologically corresponding to the performance
3 of the Valsalva maneuver, comprising:
4 defining Phase I corresponding to initial strain;
5 defining Phase II corresponding to strain duration and cessation of
6 breathing;
7 defining Phase III corresponding to strain discontinuation and
8 resumption of normal breathing; and
9 defining Phase IV corresponding to recovery.

1 46. A method according to Claim 45, further comprising:
2 identifying an overshoot of the cardiac dimensional during the Phase IV.

1 47. A method according to Claim 46, further comprising:
2 identifying an increase of the cardiac dimensional during the Phase I;
3 identifying a transient decrease of the cardiac dimensional during the
4 Phase II;

5 identifying a sharp decrease of the cardiac dimensional during the Phase
6 III; and
7 identifying an increase preceding the overshoot and a decrease of the
8 cardiac dimensional during the Phase IV.

1 48. A method according to Claim 38, further comprising:
2 providing programming support to the implantable medical device.

1 49. A method according to Claim 38, wherein the implantable medical
2 device comprises at least one of an implantable cardiac pacemaker, implantable
3 cardioverter defibrillator, implantable cardiac resynchronization device,
4 implantable cardiovascular monitor, and therapeutic device monitoring and
5 treating structural problems of the heart.

1 50. A method according to Claim 38, further comprising:
2 maintaining the intracardiac impedance measures in a database.

1 51. A method according to Claim 38, wherein the intrathoracic
2 pressure maneuver comprises at least one of the Valsalva maneuver and Müller
3 maneuver.

1 52. An apparatus for assessing cardiac performance through
2 transcardiac impedance monitoring, comprising:
3 means for directly collecting intracardiac impedance measures through an
4 implantable medical device;
5 means for correlating the intracardiac impedance measures to cardiac
6 dimensional measures relative to performance of an intrathoracic pressure
7 maneuver;
8 means for grouping the cardiac dimensional measures into at least one
9 measures set corresponding to a temporal phase of the intrathoracic pressure
10 maneuver; and

- 11 means for evaluating the at least one cardiac dimensional measures set
- 12 against a cardiac dimensional trend for the corresponding intrathoracic pressure
- 13 maneuver temporal phase to represent cardiac performance.